INDOOR AIR QUALITY ASSESSMENT

The Children's Castle
at John C. Page Elementary School
694 Main Street
West Newbury, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of Doug Gelina, Head Custodian, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality at John C. Page Elementary School (PES), 694 Main Street, West Newbury. An inspection was also conducted at the Children's Castle (a.k.a. the castle) facility. The subject of this report is the castle. Occupant concerns of symptoms potentially related to mold growth prompted the request.

On March 11, 2003, a visit was made to the castle by Cory Holmes, an Environmental Analyst in BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) program to conduct an indoor air quality assessment. Mr. Holmes was accompanied by Mr. Gelina during the assessment.

The castle is a three-story brick structure that was built as an addition to the PES in the 1980's. It is a private facility and functions independently of the PES. As such, conditions at the PES are addressed in a separate report. The castle is made up of pre-school classrooms and office space. Windows are openable.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

The castle houses approximately 100 pre-kindergarten children and has a staff of approximately 20-25. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from the table that carbon dioxide levels were elevated above 800 parts per million of air (ppm) in all areas surveyed, indicating inadequate fresh air ventilation. No means of mechanical ventilation exists in the building. Fresh air is supplied solely by openable windows.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). If a building contains mechanical ventilation, the ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this occurs a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please see Appendix I.

Temperature readings ranged from 66 °F to 71 °F, which were below BEHA's recommended comfort guidelines in some areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70 °F to 78 °F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 16 to 26 percent, which was below the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Large spaces/holes were noted along the exterior concrete foundation (see Picture 1). Although no evidence of water penetration was noted opposite these spaces on interior basement walls, these breaches in the building envelope can eventually lead to cracks and/or fissures in the foundation below ground level. Over time, this process can undermine the integrity of the building envelope and provide a means of water entry into the building by capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

Several areas on the top floor had water damaged wall plaster and efflorescence (see Picture 2), which most likely resulted from historic roof leaks (no current leaks were reported). Efflorescence is a characteristic sign of water damage to brick and mortar, but it is not mold growth. As moisture penetrates and works its way through mortar around brick, water-soluble compounds in bricks and mortar dissolve, creating a solution. As the solution moves to the surface of the brick or mortar, the water evaporates, leaving behind white, powdery mineral deposits. As discussed, water penetration can lead to mold growth under certain conditions. Repairs of leaks are necessary to prevent further water penetration. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous building materials be dried with fans and heating within 24 hours of becoming wet (ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed.

Several classrooms contained a number of plants. Plant soil, standing water and drip pans can be a potential source of mold growth. Drip pans should be inspected periodically for mold growth and over-watering should be avoided.

Conclusions/Recommendations

In view of the findings at the time of inspection, the following recommendations are made:

1. Use openable windows to control for comfort in classrooms without functioning ventilation systems. Care should be taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.
2. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
3. Repair any existing water leaks and replace/repair any water-damaged building materials. Examine the areas around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial as needed.
4. Seal/repair holes/spaces along foundation to prevent water penetration.
5. Report any signs of water penetration to the school maintenance department for prompt remediation.
6. Ensure plants have drip pans, examine drip pans for mold growth and disinfect areas with an appropriate antimicrobial where necessary.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL.

Lstiburek, J. & Brennan, T. 2001. Read This Before You Design, Build or Renovate. Building Science Corporation, Westford, MA. U.S. Department of Housing and Urban Development, Region I, Boston, MA

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Picture 1

Large Hole/Space in Concrete Foundation

Picture 2

Efflorescence/Water Damaged Wall Plaster

TABLE 1

Indoor Air Test Results –The Children's Place **March 11, 2003**

Location	Carbon Dioxide (*ppm)	Temp. (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Ms. Arlene's Office	1507	62	29	5	Y	N	N	No mechanical vent
Toddler Room	1073	66	25	10	Y	N	N	
Preschool	1084	67	22	8	Y	N	N	
Miss M.J.'s Office	1289	69	25	6	Y	N	N	Plants
Pre-Kindergarten	1210	70	23	10	Y	N	N	
Miss Letizia	1002	70	18	6	Y	N	N	
Miss Patty	2064	70	26	11	Y	N	N	
Teachers Room	1200	71	22	0	Y	N	N	
3rd Floor Hallway								Water-damaged wall plaster
Ms. Debbie	1102	71	20	0	Y	N	N	
Kindergarten	1478	71	22	10	Y	N	N	Birds nests Door open – turtles
Office	895	71	16	0	Y	N	N	

*** ppm = parts per million parts of air**

Comfort Guidelines Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%